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THE SPONTANEOUS FLORA OF AN OLD HOUSE-LOT IN EASTERN MASSACHUSETTS

RICHARD J. EATON

For several years, and intensively during 1955-56, I have attempted to collect specimens of all the vascular plants to be found growing spontaneously on the three-acre plot of land surrounding our early eighteenth century farm house in Lincoln, Massachusetts. The census is reasonably complete as of November, 1957, although subsequent additions are to be expected either as species previously overlooked or as new arrivals. In this latter category several recent instances have come to notice, thus giving striking evidence of the dynamic status of local floras. For example, a seedling of the rapidly spreading *Rhamnus Frangula* appeared in my strawberry bed early in 1954 where evidently it had been "planted" by a bird. *Aster novae-angliae* arrived in my "meadow" as two inconspicuous seedlings in 1952. A third instance is particularly interesting. A vigorous fruiting specimen of *Vitis aestivalis* emerged from a dense shrubbery behind my tennis court in 1956, festooning the wire backstop. I am convinced that there was no grapevine in the shrubbery five years earlier when I last gave it a thorough pruning. The nearest known station for this locally rare grape (where it is unquestionably indigenous) is about three-quarters of a mile to the northeast on a trap outcropping in association with the locally rare *Aster infirmus*.

The analysis of the spontaneous vegetation of this particular piece of land may be of scientific interest for several reasons. The present house with attached small barn was built about 1720.

Presumably, the house lot was cleared before that time, possibly much earlier. Judging from the apparent age of a few surviving ancient apple trees and from pictures taken about 1880, the easterly half of the lot probably has been an unplowed orchard for at least one hundred years. Its surface soil is relatively poor and unattractive for tillage. Vertical sections show vague color stratifications above the depth reached by a plow, a condition which strengthens my guess that this portion of the lot never has been plowed. It may have been pastured in the early years, and when not pastured surely mowed annually for hay. There is hearsay evidence that the "meadow" ($\frac{1}{2}$ acre \pm , described below) was used as a truck garden for an indeterminate number of years prior to 1925. Thus, ecologically speaking, one-half of the lot may have been partially shaded sod land continuously from the time it was originally cleared more than two hundred years ago, its superficial soils varying from thin sandy loam to moist deep clayey loam.

By making a reasonably convincing estimate of the composition of its original climax forest and by analyzing the present vegetation, it should be possible to make an educated guess as to what species in that forest may have survived *in situ* down to the present day. We can also indicate what native species may have invaded the area after it was cleared and still persist under existing ecological conditions. Of equal interest, perhaps, is the role played by the introduced and adventive old world species in competition with our native flora in a "civilized" habitat which has remained more or less stable for two centuries or more.

Other questions of interest emerge: What forest species indigenous to Lincoln tend to "seed in" regularly only to be destroyed by scythe or fire? (Controlled burning of the orchard grassland in December or early spring has been my usual practice since 1940.) What native species appear only in the artificial habitat of leaf mold and mulch under the shrubberies and border plantations? What weedy species conspicuously resist the severe conditions imposed on them, and what ones are conspicuous by their scarcity or absence? In this latter connection, I find that *Solidago* ssp. (notably *canadensis* and *rugosa* which were dominant in the "meadow" in 1940) survived two mowings annually but have nearly disappeared when a three-mowing schedule was inaugurated.

DESCRIPTION OF THE LOT

The three-acre lot, more accurately 2.75 acres, is a squarish trapezoid bounded on three sides by stone walls and on the east by the embankment of the town pressure reservoir. It is situated just under the crest of the highest land in Lincoln with a west-northwest exposure. High deciduous shade trees, young hemlocks, and shrubberies line the south and north boundary walls, with numerous trees of varying ages elsewhere, including a very large vigorous white pine adjacent to the barn on the north side. A very small area in the northeast corner has been allowed to grow up undisturbed for at least thirty years, as judged by the appearance of several hickory trees along the wall. The lawns, house site, garden, and tennis court occupy, roughly, the westerly half of the lot along the street. The easterly half is still primarily an orchard of mostly young fruit trees. From among the ten ancient apple trees standing in 1940 two survive. Thus, portions of the orchard are open sunny hillside. Its turf is dense and in many places interlaced with a close mesh of poison ivy runners.

The hill, except possibly its core, is of glacial origin, probably a modified drumlin, with the usual erratic boulders and underlying till. A moderate northwesterly slope dips into a shallow draw, with a gentle rise to the street. The drainage is northerly along this draw and includes effluent from a septic tank. Formerly, I am reliably informed, this draw was a narrow swamp extending to a tiny pond hole south of the property. It was drained many years ago by a covered ditch. Today part of this swampy area is the site of a "meadow". I have made a small plantation of spruce, hemlock, larch and native deciduous trees in moist rich soil on the northerly side of the meadow, thus providing a suitable habitat for several locally adventive species not present in 1940. Additions may be expected in future years when the aggressive species of sunny grassland completely fade out. Adjacent to it is a vegetable garden. The soil there is a deep clayey loam, usually moist even during very dry summers. Elsewhere on the hillside the surface soils vary from their somewhat sterile sandy loam to moderately deep clayey loam. In general, except where locally modified by applications of ground limestone, they are acid, varying slightly from pH 4.95 in the draw to pH 4.90 at the top of the orchard.

CULTURAL MANAGEMENT IN RECENT YEARS

Since 1940, the hillside orchard has been mowed once annually in June or July, and the meadow at least twice until 1950. Since then the lush growth of the latter plot has required three mowings each year. Excluding the war years, each area has been burned, generally in December or early spring, except under the fruit trees and narrow strips along the property lines. This latter practice tends to check ubiquitous poison ivy, and numerous herbaceous weeds, such as wild carrot, goldenrod, fleabane, yellow daisy, and dandelion. By burning on calm sunny days when the soil is cold and moist the slow fire seldom if ever reaches down to the crowns of the herbaceous plants and apparently has no adverse effect on seeds in the very top layer of the soil. Parenthetically, no burning was done in the springs of 1956 or 1957, nor was the orchard mowed until after the maturity of most of the grasses later in the season, in order to make collections in suitable condition for accurate determination. Weeding of the shrubberies and elsewhere was deferred for the same reason. The young fruit trees are heavily mulched with hay, and the shrubberies with leaves and compost. The garden is fertilized with spent compost from a mushroom farm and sparingly with chemicals, including ground limestone. It is cultivated regularly after each rain, thus accounting for the paucity of the usual garden weeds and for the complete absence of a few common species.

The vegetation in the meadow is now subject to considerable artificial control to improve the hay crop. Fifteen years ago the grasses were in severe competition chiefly with a large and rapidly expanding patch of *Helianthus tuberosa*, with *Solidago rugosa* and *S. canadensis*, *Asclepias syriaca*, *Equisetum arvense*, and other "weeds" in the descending order of abundance. Today, the grasses—chiefly a few lush species from the Old World—are dominant.

ANNOTATED CHECK LIST

The following lists of plants found on the house lot are based on collected specimens deposited in the Herbarium of the New England Botanical Club. I have excluded all species which have been deliberately introduced by myself or presumably so by my predecessors, including spontaneous seedlings from introduced shade trees on the place or in the neighborhood, such as *Juglans*

nigra, *Betula alba*, *Acer platanoides*, *A. saccharum*, *A. saccharinum*, and *Catalpa bignonioides* (of which a single seedling appeared for the first time in 1956). The nomenclature and sequence of families and genera follow Gray's Manual, 8th Ed. Species within a genus are listed alphabetically for convenience, authors' names being omitted for the sake of brevity.

TABLE 1

SPECIES INTRODUCED AND NATURALIZED FROM THE OLD WORLD

- Bromus commutatus*. Scarce. First observed in 1956. Vineyard.
Festuca elatior. Common. Variable. Meadow and orchard.
F. ovina. Scarce. Rocky, sterile soil on retaining wall.
Poa compressa. Scarce. Dry, stony soil, edge orchard.
Dactylis glomerata. Common. Meadow and orchard.
Lolium perenne. Lush turf. Near edge of lawn.
Arrhenatherum elatius f. *biaristatum*. Scarce. Vineyard.
Agrostis alba. Abundant in moist ground.
A. canina f. *mutica*. Several large colonies. Sunny orchard.
A. tenuis. Rather scarce. Moist sunny orchard.
Phleum pratense. Scarce. Meadow and sunny orchard.
Anthoxanthum odoratum. Common. Moist soil. Banks, orchard, etc.
Digitaris Ischaemum. Common. Lawn, tennis court, etc.
D. sanguinalis. Abundant. Lawn, garden, shrubberies, etc.
Setaria glauca. Abundant. Meadow, garden weed.
Carex spicata. Rather scarce. Orchard.
Asparagus officinalis. Occasional. Dry upper orchard.
Ornithogalum umbellatum. Frequent. Meadow, shrubberies, etc.
Rumex Acetosa. Abundant. Rich soil in restricted area of orchard.
R. Acetosella. Abundant. Sterile, acid soils throughout.
R. crispus. Common. Meadow.
R. obtusifolius. Scarce. Meadow.
Polygonum aviculare. Abundant weed in thin lawn, sidewalks, etc.
P. Convolvulus. Scarce and transient. Sunny bank of meadow.
P. Persicaria. Common. Perennial beds, garden, meadow.
Chenopodium lanceolatum. Frequent in orchard.
Portulaca oleracea. Common garden and lawn weed.
Stellaria media. Abundant weed in disturbed moist soils.
Cerastium vulgatum. Abundant, chiefly as weed in lawn.
Ranunculus repens. Common. Meadow, moist lawn, shrubberies.
R. acris. Common. Drier portions of orchard.
Berberis vulgaris. Frequent as seedlings under trees, shrubberies.
Capsella Bursa-pastoris. Very scarce. Thin lawn.
Barbarea vulgaris var. *arcuata*. Very scarce.
Sedum purpureum. Abundant and aggressive.
Trifolium agrarium. Very scarce. Dry sandy soil. Orchard.
T. pratense. Scarce. Moist rich slope. Orchard.
T. repens. Abundant, moist sunny orchard. Lawn.
Vicia Cracca. Abundant in two areas of orchard.
Rhamnus Frangula. Sporadic as seedling in strawberry bed.
Daucus Carota. Abundant. Meadow, orchard, etc.

Lysimachia Nummularia. A single large patch near the White Pine.
Prunella vulgaris. Abundant. Moist lawn, meadow, etc.
Solanum Dulcamara. Common. Moist ground under shrubberies, trees, etc.
Verbascum Thapsus. Frequent as seedlings in light soil.
Veronica serpyllifolia. Abundant, moist lawn.
Plantago lanceolata. Common. Lawns, meadow, etc.
P. major. Abundant except in orchard.
 × *Lonicera bella*. Sporadic as seedlings under apple trees.
Achillea Millefolium. Scarce. Dry, sunny orchard.
Chrysanthemum Leucanthemum var. *pinnatifidum*. Scarce. Edge of meadow.
Tanacetum vulgare. Sporadic. Nursery.
Arctium minus. Sporadic as seedlings.
Cirsium vulgare. Sporadic as seedlings.
Cichorium Intybus. Scarce. Meadow, moist orchard.
Leontodon autumnalis. Abundant. Meadow, orchard, lawn.
Taraxacum erythrospermum. Formerly abundant in drier parts of lawn.
T. officinale. Formerly abundant in meadow and richer portions of lawn.
Hieracium aurantiacum. Scarce. First noticed in 1955.
H. florentinum. Very scarce. Dryish ground in orchard.

This list totals 60 species in 45 genera from 21 families.

Those species of the foregoing genera which more or less resist an attempt to eradicate them appear to be assisted in their continued occurrence by the following agencies: *Daucus*, germination of long dormant seeds(?); *Solanum*, birds; *Arctium*, animals; *Cirsium*, wind; *Taraxacum*, wind; *Hieracium aurantiacum*, wind. Because of their customary appearance as seedlings under trees and food-yielding shrubs the following doubtless are also spread by birds: *Asparagus*, *Berberis*, *Lonicera*. I am at a loss to account for the prevalence of *Sedum purpureum* and of its constant appearance as a weed in the infrequently cultivated portions of the garden, such as the strawberry bed.

TABLE 2

SPECIES INTRODUCED OR ADVENTIVE AND NATURALIZED FROM THE NEW WORLD

Mollugo verticillata. Common weed.
Geranium Robertianum. Abundant. Weedy in shrubberies and elsewhere.
Cuscuta campestris. A single vigorous plant appeared in 1957, parasitic on garden carrot.
Solanum rostratum. A single plant, 1956. Garden.
Aster novae-angliae. Scarce. Meadow. First appeared about 1953, possibly locally native.
Galinsoga ciliata. Occasional. Garden and disturbed ground.
Helianthus tuberosa. Meadow. Resists eradication.
Rudbeckia serotina. Abundant. Orchard and dry banks.

This list totals 8 species in 8 genera from 5 families.

TABLE 3

NATIVE IN EASTERN MASSACHUSETTS
BUT PRESENT POPULATIONS PROBABLY ORIGINATING FROM OUTSIDE THE LOT

- Pinus Strobus*. Occasional as seedlings along walls.
Festuca rubra. Common. Orchard.
F. rubra var. *commutata*. Apparently scarce. Unmowed bank.
Poa pratensis. Common. Meadow, orchard.
Eragrostis spectabilis. Frequent. Orchard.
Agropyron repens var. *subulatum*. Abundant. Meadow, orchard.
Agrostis perennans. Frequent. Orchard.
Muhlenbergia frondosa. Frequent. Shrubberies, disturbed ground.
M. mexicana. Scarce, several clumps. Orchard.
M. Schreberi. Frequent. Shrubberies, disturbed ground.
Paspalum ciliatifolium var. *Muhlenbergii*. Rather common. Orchard.
Panicum capillare var. *occidentale*. Not common. Orchard.
P. lanuginosum var. *fasciculatum*. Frequent. Orchard.
P. lanuginosum var. *implicatum*. Frequent. Orchard.
P. spretum. Scarce. Orchard.
Echinochloa pungens var. *Wiegandii*. Scarce. Orchard.
Andropogon scoparius var. *frequens*. Scarce. Orchard.
Cyperus strigosus. Frequent. Orchard, meadow, cultivated ground.
Carex annectens. Not common. Orchard.
Juncus tenuis. Abundant weed. Tennis court.
Maianthemum canadense. Abundant. Edge of meadow under white pine.
Sisyrinchium atlanticum. Scarce. Orchard.
S. montanum var. *crebrum*. Scarce. Orchard.
Habenaria lacera. Two plants. Orchard. First observed in 1957 as new arrival(?).
Spiranthes cernua. Sporadic. Orchard.
Carya glabra. Frequent as seedlings. Orchard. Several young fruiting trees.
C. tomentosa (?). A single sapling about 8 years old. Bank, edge of meadow.
Corylus americana. Scarce. Thicket around large boulder.
Betula populifolia. Strawberry bed, as occasional seedlings.
Quercus alba. Frequent as seedlings especially under apple trees. Orchard.
Q. rubra. Frequent as seedlings. Orchard.
Ulmus americana. Property line, 2 tall trees. Occasional as seedlings under shrubs.
Pilea pumila. Abundant weed in one location under shrubs.
Polygonum Hydropiper. Weed in vineyard, perennial bed.
P. pennsylvanicum var. *laccigatum*. Weed in vineyard, perennial bed.
Phytolacca americana. Common weed in shrubberies, etc.
Sagina procumbens. Common weed along sandy flagstone path, shrubbery.
Spiraea latifolia. Very scarce but surviving repeated burns. Orchard.
Fragaria virginiana. Two large clones. Orchard.
Potentilla canadensis. Common. Orchard, thin lawn.
Geum laciniatum var. *trichocarpum*. Scarce. Plantation, shrubberies.
Rubus Enslenii. Very scarce. Orchard.
R. occidentalis. Frequent as seedlings under old trees, along walls, etc.
R. pennsylvanicus. Encroaching from neighboring field.
Prunus serotina. One well grown tree. Frequent as young sprouts in orchard.
P. virginiana. Several mature specimens. Thicket.

- Oxalis europaea* forma *villicaulis*. Abundant. Orchard, lawn, shrubberies.
Geranium maculatum. Well established near plantation.
Acalypha rhomboidea. Common. Orchard, moist shrubberies, garden.
Euphorbia supina. Abundant weed. Driveway, thin lawn.
Celastrus scandens. A single old vine. Numerous root shoots in vicinity.
Impatiens capensis. Abundant. Edge of meadow.
Parthenocissus quinquefolia. Orchard, along southwall. Also as frequent seedlings.
Vitis aestivalis. A single specimen, recently established. Shrubbery.
Hypericum mutilum var. *parviflorum*. Frequent. Moist open shrubbery.
H. perforatum. Scarce. Orchard.
Viola cucullata forma *albiflora*. Scarce. Meadow, orchard.
Epilobium coloratum. Frequent. Moist open shrubbery.
Circaea quadrisulcata var. *canadensis*. Frequent. Moist open shrubbery.
Cornus alternifolia. Scarce. Orchard thicket.
Vaccinium angustifolium var. *laevifolium*. Scarce. Orchard, slope.
Lysimachia quadrifolia. Large clone, under white pine.
Fragaria americana. Frequent. Shrubberies, etc., as seedlings.
Asclepias syriaca. Nearly eradicated. Formerly abundant.
Convolvulus sepium. Persistent in three locations.
Verbena urticifolia. Scarce. Plantation. Sporadic elsewhere.
Solanum americanum. Sporadic weed. Garden.
S. carolinense. Large clone. Orchard. Spreads rapidly unless checked.
Physalis heterophylla. Upper orchard. Thin sandy soil where under observation since 1940. Two or three stems first appeared in 1956 under old apple tree north side of house on disturbed sandy bank.
Linaria canadensis. Scarce. Shrubbery.
Orobancha uniflora. Very scarce and sporadic. Edge of meadow (1946). Orchard near south wall (1952).
Plantago Rugelii. Ubiquitous weed. Meadow, lawn, shrubberies, etc.
Solidago caesia. Persistent in a single location behind tennis court.
S. canadensis. Frequent, formerly abundant. Meadow, lower orchard.
S. juncea. Frequent. Orchard.
S. nemoralis. Frequent. Orchard.
S. rugosa. Common. Orchard, meadow.
Aster ericoides. Scarce. Orchard.
A. lateriflorus. Common. Orchard.
A. lateriflorus var. *pendulus*. Scarce. Orchard.
A. linariifolius. Scarce. Orchard.
A. undulatus. Abundant. Orchard.
Erigeron annuus. Abundant. Meadow, orchard, lawn.
E. canadensis. Common. Orchard.
E. pulchellus. Several large clones. Orchard.
Antennaria neglecta. Common. Orchard.
A. neodioica. Common. Orchard, lawn.
A. plantaginifolia. Scarce. Orchard.
Gnaphalium obtusifolium. Common. Orchard.
Ambrosia artemisiifolia var. *elatiior*. Abundant. Orchard.
Bidens frondosa. Sporadic. Shrubbery.
Lactuca canadensis var. *latifolia*. Meadow where weedy. Orchard where frequent.
L. canadensis var. *longifolia*. Common. Orchard.

This list totals 88 species in 65 genera from 37 families.

Assignments to the category of Table 3 are the result chiefly of subjective judgment. One basic assumption which has influenced my opinion is that the lot had been mowed annually for many years right up to the property lines, except for a small thicket near a big boulder in the northeast corner. The reasons for this assumption, not stated here, seem to me to be convincing. Therefore, all the spontaneous trees and most of the shrubs are listed here. Those native herbaceous plants collected in the unplowed orchard, which appear to require the specialized habitat of dry, sunny sterile soils, presumably have invaded the lot after it was originally cleared. Furthermore, it is a fact that the plantation and most of the shrubberies were established by me after 1940. There seems to be little doubt about the recent invasion of those species found only in the artificial habitats of plantation, shrubberies, tennis court, lawns, driveways and other disturbed soils. It is conceivable, however, that *Corylus*, *Prunus virginiana* (both immediately adjacent to the boulder in the thicket), *Geranium maculatum*, *Cornus*, *Asclepias*, and *Solanum carolinense* have been present in the lot since pre-colonial times.

There are several species listed in Table 3 which appear to occur only in disturbed or artificial soils, in the leaf mold of shrubberies, or in mulched areas where there is little competition from aggressive herbaceous vegetation. These, referred to by generic name only in cases where the identities are in no doubt, are as follows: *Muhlenbergia* (both species), *Juncus*, *Betula*, *Ulmus* (the seedlings), *Pilea*, *Polygonum* (both species), *Phytolacca*, *Sagina*, *Geum*, *Geranium*, *Euphorbia*, *Impatiens*, *Vitis*, *Hypericum*, *Epilobium*, *Circaea*, *Fragaria*, *Verbena*, *Solanum americanum*, *Linaria*, *Bidens*.

TABLE 4

NATIVE IN EASTERN MASSACHUSETTS
AND VERY POSSIBLY PERSISTENT *in situ*, FROM PRE-COLONIAL TIMES

- Equisetum arvense*. Abundant. Meadow, borders, garden weed.
Osmunda cinnamomea. Scarce. Orchard, chiefly along south wall.
O. Claytoniana. Common. Orchard, chiefly along south wall.
O. regalis var. *spectabilis*. Very scarce. Orchard, in moist sod land.
Onoclea sensibilis. Abundant. Meadow, orchard.
Dryopteris Thelypteris var. *pubescens*. Abundant. Orchard.
Athyrium Filix-femina var. *Michauxii*. Frequent. Orchard, along south wall.
A. Filix-femina var. *Michauxii* f. *elatius*. Frequent. Orchard, along south wall.
A. Filix-femina var. *Michauxii* f. *laurentianum*. Very scarce. Orchard.
A. thelypteroides f. *acrostichoides*. Very scarce. Orchard.

- Carex cephalophora*. Frequent. Orchard.
C. normalis. Rather scarce. Orchard.
C. pallescens var. *neogaea*. Rather scarce. Orchard.
C. pennsylvanica. Frequent. Orchard.
C. scoparia. Not common. Orchard.
C. Swanii. Very scarce. Orchard.
C. tenera. Common. Orchard.
Luzula multiflora. Rather common. Orchard.
Apios americana. Two colonies. Along north and south walls.
Rhus radicans. Abundant and ubiquitous. Orchard. Seedlings repeatedly appearing in shrubberies, under trees, nursery, etc.
Viola papilionacea. Abundant. Orchard. Also as weed in shrubberies.
Apocynum androsaemifolium. A single large clone. Orchard near thicket. Also one seedling found in raspberry bed in 1956.
Aster cordifolius. Common. Orchard. Along walls. Also abundant weed in shrubberies and disturbed ground.
A. novi-belgii. Scarce, nearly extirpated. Meadow.
A. puniceus var. *compactus*. Scarce, nearly extirpated. Meadow.
A. vimineus. Common. Orchard.

This list totals 24 species in 12 genera from 10 families.

Many of the species which I have assigned to Table 3 possibly were sparse or rare constituents of the original flora of the lot. However, I have excluded from Table 4 most of the forage plants (those grasses, sedges and other herbaceous species frequently disseminated directly or indirectly by grazing animals), and also aggressive species shedding wind-borne seeds or attractive to seed- and fruit-eating birds. The mere fact that with due diligence we can find most of them in our fourth-growth woodlands is no proof that they occurred normally in a virgin deciduous forest except as transients in naturally disturbed soils or habitats, such as blow-downs and "burns" started by Indians or rarely by lightning. These considerations lead to the inevitable reflections concerning the profound change in the composition and relative abundance of our local flora, which has occurred during the past three hundred years. The conversion of the wilderness to farm land with its multiplicity of wood lots, pastures, mowings, fence rows, stone walls, ditches, roadsides and thickets offers numerous suitable habitats for hundreds of species where few or none existed under primitive conditions. Hence, a large number of our native species, now common to abundant throughout the countryside, originally must have been uncommon, or local, or even rare, for the simple reason that favorable habitats were scarce.

In attempting to sort out the species which may have survived *in situ* as a relic of the primeval flora of the lot it is first necessary to reconstruct the probable nature of the forest growth before the

land was cleared and to visualize the various ecological niches provided by it, with due reference to physical characteristics of the site as described earlier in this paper. It is then possible to consider whether the ecological requirement of each native species now growing on the lot is consistent with the ecological niches reasonably assumed to have been provided by its original forest cover. As a clue to this problem, there is a patch of rocky woods on the steeper north slope of our hill at a distance of about three hundred meters but at a somewhat lower elevation. Although badly mauled by the series of hurricanes during the past twenty years, it has every appearance of being a relatively undisturbed remnant of the original forest. It consists mainly of a mixed deciduous hardwood forest. A brief winter inspection reveals the following species (doubtless among others): *Pinus rigida*, *Juglans cinerea* (a single aged and dying specimen), *Carya* sp., *Betula lenta* (now the most abundant species and rapidly invading the openings made by windfalls), *Quercus alba*, *Q. rubra*, *Ulmus americana* and *Fraxinus americana*. There are also a few large stumps of *Castanea dentata*. At the lower edge of this wooded patch is a small water course which, in fact, is a continuation of the covered drainage ditch in my meadow. Its herbaceous vegetation is what one might expect in an area such as this: ferns, grasses, sedges, and the other elements of a flora to be found in dry to moist woods, glades, and along partially shaded runnels. Prior to the hurricanes there were several very large old white oaks on the southern flank of our hill, and, according to an old neighbor, a small grove of ancient chestnut trees in the vicinity, most of which were removed between 1875 and 1900.

It is probable, therefore, that mature deciduous trees grew originally on my portion of the hill, effectively suppressing sapling growth under them and offering a suitable habitat for a varied herbaceous flora in dry, moist and swampy open woods. I conclude that the foregoing list represents a remnant of the original flora—a remnant capable of persisting under the harsh ecological conditions imposed by mowing, burning and competition with introduced species.

It is of some interest, perhaps, to note that the following plants listed in Tables 3 and 4, although indigenous to the lot or in the neighboring region, behave in a weedy manner in one or more of the various "artificial" habitats on my place, viz., meadow, garden,

shrubberies, plantation, lawn, tennis court, but occur sparingly if at all on undisturbed soils: *Equisetum*, *Onoclea*, *Agropyron*, *Muhlenbergia* sp., *Cyperus*, *Juncus*, *Pilea*, *Polygonum* sp., *Phytolacca*, *Sagina*, *Geum*, *Potentilla*, *Geranium*, *Oxalis*, *Acalypha*, *Hypericum mutilum*, *Epilobium*, *Circaea*, *Plantago* ssp., *Aster cordifolius*, *Erigeron annuus*, *Helianthus*, *Bidens*, *Lactuca*.

In certain instances there is indirect evidence of the means of dissemination, aside from those plants whose seeds are obviously windblown or have been introduced in manure and lawn grass seed. Seedlings of the following plants occur almost exclusively under apple trees used by nesting robins or under juicy fruited shrubs attractive to catbirds, starlings, and robins, and other fruit-eating birds: *Asparagus*, *Phytolacca*, *Berberis*, *Rhus*, *Parthenocissus*, *Rhamnus* (strawberry bed), *Physalis*, *Lonicera*. I have alluded to the surprising appearance of *Vitis aestivalis*. Mentioning the occurrence to an ornithological friend, he asked if I had ever seen Ruffed Grouse on my place. When I assured him that I had recorded Grouse on at least three widely separated occasions he said that Grouse were fond of ripe grapes and apparently ate them whole. I have never permitted *Arctium* or *Bidens* to reach maturity on my place, but having observed that my dog frequently comes home with an assortment of burs in his coat, it is reasonable to assume that long coated animals (dogs, cats, skunks or foxes) have transported the seeds in these two cases. The frequent occurrence of hickory and oak seedlings in the orchard is probably due to Gray or Red Squirrels, although Jays and Crows cannot be excluded as possibilities.

The Flora of the Boston District, published serially in RHODORA,

TABLE 5

AGGREGATE COUNT OF FAMILIES, GENERA AND SPECIES COMPARED WITH THE FLORAS OF THE BOSTON DISTRICT AND OF GRAY'S MANUAL RANGE

	Families	Genera	Species			
			Introd.	Native	Total	% Native
Lincoln House Lot	53	95	66 ¹	110 ²	176	62.5
Boston District	133	697	789 ¹	1312 ²	2101	62.5
Gray's Manual Range	168	1133	1098	4425	5523	80.1

¹ Introduced and naturalized or adventive from outside eastern Massachusetts.

² Native in eastern Massachusetts.

Vols. 9-26 incl., comprises a preliminary list of all Pteridophytes and Spermatophytes, including varieties and named forms, reliably reported to a committee of the New England Botanical Club as growing without cultivation in a precisely defined area which is here roughly described as within thirty miles of Boston. Lincoln is fifteen miles due west of Boston.

The Boston District figures are derived from an unverified count of the taxa involved. Accuracy, as of the present day, is impossible because the list has never been brought up to date either in respect to nomenclature or additions. However, it is unlikely (by the law of chances) that the ratio of native species to total species would be significantly different were an up-to-date list available. Incidentally, it is, of course, a sheer coincidence that this ratio of 62.5%, as stated above, is exactly the same as that for the Lincoln house lot! The significant point is that they are of the same order of magnitude and are in marked contrast to the ratio of 80.1% for Gray's Manual range. Here, it seems, is a bit of concrete evidence of the truth of the commonly accepted assumption that the exotic elements of the floras of long and densely settled areas of this country (e.g., along the eastern seaboard) are much larger than of the relatively youthful regions (e.g., Mississippi basin and prairie states). It takes time for introductions to spread, even when suitable habitats are available. Perhaps in this age of universal motor travel the tempo of the spread is being greatly accelerated.

The figures in Table 5 well illustrate the diversity of our local flora. My house lot of less than three acres contains nearly 8.5% of the species reported from the Boston District (approximately 1900 square miles of which a substantial fraction is salt marsh and sand dune). The Boston District, less than one-quarter of the area of Massachusetts, contains 38% of the species recorded from the entire Gray's Manual range. This diversity is even more striking in respect to genera and families.—LINCOLN, MASSACHUSETTS.

THELEPOGON ELEGANS ROTH IN THE DOMINICAN REPUBLIC.—Specimens of this tropical Old World grass recently came to hand for determination, with the information that it is becoming a pest in the rice fields of the Dominican Republic. In its immature stages it resembles rice plants rather closely, thus making more difficult the application of selective control measures.—O. E. JENNINGS, CARNEGIE MUSEUM.

THE FRUTICOSE AND FOLIOSE LICHENS OF WORCESTER COUNTY, MASSACHUSETTS.¹

VERNON AHMADJIAN

The study of lichens has undoubtedly been discouraging to many who have become interested in these forms, due to the lack of simple and readily available keys. It is hoped that this work will be useful in the identification of lichens and help to contribute to the fulfillment of this major need in the field of lichenology.

Although the present work is regional in its scope, the lichens described are by no means localized and can be readily found throughout the northeastern part of the United States. The keys, however, have been designed specifically from material collected within Worcester County. Anyone attempting to determine lichens from outside of this region should bear this in mind.

Only the fruticose and foliose lichens have been dealt with because the crustose forms are too difficult to be given a simple and yet adequate treatment suitable for beginners.

Worcester County, making up the central part of Massachusetts, is the largest county in the state, and consists of an area of approximately 1,522 square miles or 974,000 acres. It extends 35 miles from east to west and 50 miles, or the entire width of the state, from north to south. The county is characterized by ranges in elevation of from 800-1,200 feet, excluding the extremely low and high points, and shows a remarkable uniformity of the horizon line. The most notable of the remnants of elevations above the plateau surface still existing are Mt. Wachusett in Princeton, elevation 2018 ft., Little Wachusett, Princeton, elevation 1,559 ft. and Asnebumskit Hill, Paxton, elevation 1,395 ft. Throughout the county many rocks have been scattered as a result of the glaciation; contacts of schist and granite are most prevalent.

The climate of Worcester County is as variable as that in any temperate region. In general, the winter temperature averages about 26 degrees with a minimum recorded of -24 degrees and the average summer temperature is about 69 degrees, with a maximum recorded of 103 degrees. The average annual precipitation is 42.3 inches.

¹ This contribution is part of a thesis submitted to Clark University, Worcester, Massachusetts, for the degree of Master of Arts, 1954-1956.

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LITERATURE USED IN THE IDENTIFICATION OF LICHENS

For an introduction to lichenology, the Lichen Book by G. G. Nearing has proved to be most satisfactory. It describes approximately 500 lichens, most of which are commonly found in the north-eastern part of the United States, and its illustrations and descriptions are good. Unfortunately, the approach is rather unscientific and the keys are not too usable.

Lichens by Annie Lorrain Smith is an excellent book embracing virtually all aspects of lichenology, from the history of lichens to their physiology, ecology, morphology, etc. It also has an extensive bibliography and is an invaluable book for those who are interested in studying this group of plants.

The Lichen Flora of the United States by Bruce Fink gives a comprehensive survey of the lichens of the United States and serves as a good reference book. Its keys, however, are difficult and poorly constructed and on the whole the beginner would find the book rather cumbersome.

For those wishing to go on further in the study of lichens, Rabenhorst Kryptogamen Flora provides an excellent treatment, with keys and descriptions of the various lichen groups. Each group treatment is the work of an expert in that particular area. The section on lichens in Engler and Prantl, *Die Natürlichen Pflanzenfamilien*, is also worthy of notice here, containing good keys and descriptions.

The *Catalogus Lichenum Universalis* by A. Zahlbruckner is another indispensable piece of lichenological literature containing all known lichen taxa up to 1940, and giving nomenclature and references to literature pertaining to each lichen that is listed. Consisting of ten volumes, it contains over 17,000 lichen names, many of which, however, have now been outdated. Dr. I. Mackenzie Lamb is at present working on an extension of this treatment by Zahlbruckner which will bring this list of known lichens up to date.

The Lichen Handbook² by Mason E. Hale is an excellent up-to-date booklet on lichenology and includes sections on the chemistry, reproduction, phytogeography, and classification of lichens. Prepared from a series of lecture notes on the subject, it reviews all aspects of the field and would be of much value to beginners.

For recent lichenological works or studies, *The Bryologist*, a quarterly journal of the American Bryological Society, would be a likely source containing a section listing recent literature on lichens by William L. Culberson. *Rhodora*, a monthly journal of the New England Botanical Club, is another possible reference source.

KEY TO THE MAIN GROUPS OF LICHENS

- Thallus elongated, shrubby to band-like or thread-like, erect or pendulous, usually branched; arising either directly from the substratum by a basal holdfast, or from a primary thallus, in some instances dying off at the base. Fruticose Lichens.
- Thallus flattened, leaf-like, dorsiventral, with a visible difference between upper and under surfaces; partly free from the substratum, to which it is relatively loosely attached, usually by rhizoids. Foliose Lichens.
- Thallus crust-like, closely applied and wholly fused to the substratum by the underside; not detachable except by scraping off in small fragments; commonly areolate, divided by cracks into small island-like portions. Crustose Lichens.

KEY TO THE GENERA OF FRUTICOSE LICHENS

1. Thallus flattened; primary thallus absent. 2
1. Thallus not flattened, cylindrical; primary thallus present or absent. . . . 4
2. Thallus soft and flaccid when dry, usually pendulous. . . *Evernia mesomorpha* Nyl. On bark. Thallus greenish or yellowish-green, sorediose. Spores simple, one-celled.
2. Thallus rather stiff and rigid, erect. 3
3. Thallus yellowish, almost always without marginal spinules. . . . *Ramalina pollinaria* (Liljebl.) Ach. Branches short, tips bursting open, densely farinose sorediate. Spores two-celled.
3. Thallus brownish, with marginal spinules. CETRARIA, p. 77
4. Stalks solid. 5
4. Stalks hollow or loosely filled. 7
5. Stalks with tough tensile cartilaginous central core. 6
5. Stalks without tough tensile cartilaginous central core. . . *Baeomyces roseus* Pers. On sandy banks along roadside. Very common. Primary thallus crustose, gray. Podetia simple, white or pinkish, bearing single mushroom-like pink apothecia. Thallus bearing scattered white or greenish globules.
6. Thallus greenish to silver-gray; assimilative branches squamulose, coralloid, or granulose. STEREOCAULON, p. 81
6. Thallus greenish-gray; assimilative branches filamentous. . . . USNEA, p. 81

² Available from the author: Mason E. Hale, Division of Cryptogams, Smithsonian Institution, United States National Museum, Washington 25, D. C.

7. Thallus hair-like. *Alectoria nidulifera* Norrl. On rocks and rotting wood. Thallus sorediate. Apothecia rare.
 7. Thallus cylindrical, shrubby or dendroid. CLADONIA, p. 77

KEY TO THE SPECIES OF FRUTICOSE LICHENS

CETRARIA

1. Thallus having scattered brown or black tubercles. Apothecia originating from under surface. *Cetraria ciliaris* Ach. On bark.
 1. Thallus having no tubercles. Apothecia, if present, originating from upper surface. *Cetraria islandica* (L.) Ach. On ground in pine woods. Stalks strap-shaped, forking, thin, curling when dry to form a trough-like structure.

CLADONIA

1. Primary thallus crustose, gray. Podetia simple or branched, brown tipped. Apothecia brown and clustered. *Cladonia papillaria* (Ehrh.) Hoffm. On ground.
 1. Primary thallus squamulose or disappearing. 2
 2. Primary thallus disappearing, rarely present. Podetia branched, usually elongated and entangled, dying off at the base. 3
 2. Primary thallus squamulose, persistent. 12
 3. Podetia squamulose, usually erect and sterile, showing openings in branch axils, grayish-green, rarely brownish. Apothecia, if present, brown. . . . 4
 3. Podetia not squamulose. 5
 4. Podetia slender, entangled, warty in appearance. KOH—, Pd+ red. *Cladonia furcata* (Huds.) Schrad. On ground. Var. *palamaea* (Ach.) Vainio. Podetia brownish. Var. *pinnata* (Flk.) Vainio. Podetia densely squamulose.
 4. Podetia somewhat swollen, little entangled, covered sparingly with granular soredia. KOH—, Pd+ red. *Cladonia scabriuscula* (Del.) Vainio. On ground.
 5. Podetia entangled, short, spinose at tips, usually forming sponge-shaped tufts. KOH—, Pd— 6
 5. Podetia entangled, or little entangled. Extreme tips blunt to hair-like, drooping or erect. 7
 6. Extreme tips spinose, branch axils usually perforated. *Cladonia uncialis* (L.) Web. On ground in rocky hillside pastures. Very common.
 6. Podetia much enlarged, contorted, flabby, showing lattice-like openings. *Cladonia Boryi* Tuck. On ground.
 7. Podetia abundantly farinose-sorediate, little entangled. KOH—, Pd+ red. *Cladonia farinacea* (Vainio) Evans. On ground.
 7. Podetia esorediate. 8
 8. Podetia silver-gray and smooth or warty to granular in older specimens. Tips brownish, usually divided into whorl-like arrangements and then each tip subdivided into many drooping finger-like projections. KOH + yellow, Pd+ red. *Cladonia rangiferina* (L.) Web. On ground in rocky hillside pastures. Fairly common. f. *crispata* Coem. Podetia more densely branched and colonies more compact.
 8. Podetia greenish or yellowish-gray. 9
 9. Podetia slender, tips forked, hair-like; branch axils usually closed. KOH + yellow, Pd+ red. *Cladonia tenuis* (Flk.) Harm. On ground in open fields and hilly pastures. Very common.

9. Podetia polytomously branched; branch axils usually perforated. 10
10. Tips not usually darkened, tending to curve in one direction. KOH —, Pd + red. *Cladonia sylvatica* (L.) Hoffm. On ground in rocky hillside pastures.
10. KOH —, Pd —. 11
11. Podetia forming rather loose branch-systems; extreme tips rather long, diverging in various directions. *Cladonia mitis* Sandst. On ground.
11. Podetia thickened, tips short and numerous. *Cladonia submitis* Evans. On ground.
12. Podetia usually lacking or very short. Apothecia, if present, brown, resting on or appearing immersed in the primary squamules. 13
12. Podetia present, well-developed, simple or branched, cylindrical or cup-forming. 14
13. Primary squamules small, margins serrated into fine tooth-like lobes. Usually sterile. Apothecia, if present, large, lumpy. KOH —, Pd + red. *Cladonia caespiticia* (Pers.) Flk. On ground, rotting wood, bark. Very common.
13. Primary squamules long, strap-shaped, notched at tips, blue-gray, curling upward when dry showing white under surface. KOH + yellow, Pd + red. *Cladonia apodocarpa* Robbins. On ground. Common.
14. Podetia clustered to form more or less matted colonies; apothecia brown. 15
14. Podetia separate, not forming mat-like colonies. 18
15. Podetia cupless, having openings in branch axils; often squamulose. KOH —, Pd + red. *Cladonia furcata* (Huds.) Schrad.
15. Podetia usually covered in various degrees with large or minute squamules; usually forming open cups which broaden out gradually or abruptly; irregular dichotomous branching. 16
16. Podetia forming cups with sieve-like openings. *Cladonia turgida* (Ehrh.) Hoffm., f. *squamulosa* (Rabenh.) Theobald. On ground. Podetia squamulose.
16. Podetia not forming cups with sieve-like openings. 17
17. Podetia densely covered with minute or large squamules. KOH —, Pd —. *Cladonia squamosa* (Scop.) Hoffm. f. *squamosissima* Flk. Podetia densely squamulose.
17. Podetia not densely covered with squamules; forming well developed cups 2-4 mm. in diameter. KOH +, Pd +. *Cladonia carassensis* Vainio, f. *regularis* Vainio. On ground. Podetia repeatedly proliferating with short stories (2-13 mm.) Cups small, regular, usually abruptly dilated. No squamules.
18. Podetia scyphous, forming cups. 19
18. Podetia ascyphous, not cup-forming. 34
19. Podetia cylindrical, except at the extreme tips where they expand abruptly to form small cups. Apothecia brown. 20
19. Podetia expanding gradually to form rather large cups. 25
20. Cups funnel-shaped, usually opening into podetial cavity. Podetia never sorediose. 21
20. Cups closed, shallow. Podetia sorediose. 22
21. KOH —, Pd —. *Cladonia squamosa* (Scop.) Hoffm.
21. KOH +, Pd +. *Cladonia carassensis* Vainio.
22. Podetia farinose-sorediate throughout except for a small portion at base. Cups merely small depressions in slightly expanded tips, often lacking and the podetia pointed and horn-like at the tips. KOH —, Pd +

- red. *Cladonia coniocraea* (Flk.) Spreng. On ground, rotting wood, bark. Very common. f. *phyllostrota* (Flk.) Vainio. Podetia squamulose. f. *stenoseypha* (Stuekenberg) Sandst. Podetia forming cups, narrow at the mouth, often abortive.
22. Podetia granular-sorediate, or if farinose, mixed with granules. 23
23. Podetia usually over 15 mm. long, covered with finely granular soredia only on upper part; expanded at tips to form shallow star- or wand-shaped cups; or cupless and simple. KOH —, Pd + red. *Cladonia nemozyna* (Ach.) Nyl. On ground and rotting wood. Very common.
23. Podetia short, less than 15 mm. long. KOH —, Pd + red. 24
24. Podetia covered with farinose soredia, mixed with coarse granules. *Cladonia cylindrica* Evans. On ground. f. *scyphifera* Evans. Podetia stout, forming distinct cups at the tips.
24. Podetia covered with coarse granular soredia. *Cladonia pityrea* (L.) Hoffm. On rotting wood. Common.
25. Cups flat, shallow, saucer shaped, usually proliferating once or several times. Apothecia brown. 26
25. Cups deep, goblet shaped, rarely proliferating, and then usually only once. Apothecia brown or red. 27
26. Proliferations few, from margins of cups. *Cladonia gracilis* (L.) Willd. On ground.
26. Repeated proliferations from center and margins of cups, or from sides of podetia. KOH —, Pd + *Cladonia verticillata* Hoffm. On rotting wood and ground. Very common. f. *aggregata* (Del.) Oliv. Proliferations central and numerous. f. *apoteca* (Ach.) Vainio. Podetia with proliferations along the sides as well as from the centers of the cups. f. *phyllocephala* (Flat.) Oliv. Podetia squamulose.
27. Apothecia, if present, red. Podetia pale bluish to yellowish-green. 28
27. Apothecia, if present, brown. Podetia grayish-green to brownish. 29
28. Podetia usually covered with coarse granular soredia, rarely farinose. KOH —, Pd — *Cladonia pleurota* (L.) Willd. On ground. Common. Var. *frondescens* (Nyl.) Oliv. Podetia squamulose.
28. Podetia dusted with fine soredia, farinose; long, usually contorted and stout. Proliferations, if present, from margin of cup. KOH —, Pd — *Cladonia deformis* (L.) Hoffm. On ground.
29. Podetia esorediose. KOH —, Pd + red. *Cladonia pyxidata* (L.) Hoffm. On ground and rotting wood. Very common.
29. Podetia sorediose. 30
30. Soredia farinose. 31
30. Soredia granular. 33
31. Cups narrow, slender, sometimes lacking, KOH —, Pd + red. *Cladonia fimbriata* (L.) Fr. Soredia throughout length of stalks. On ground.
31. Cups rather well formed, rarely lacking. 32
32. Podetia forming distinct cups with marginal proliferations. KOH —, Pd + red. *Cladonia cornutoradiata* Sandst. On ground. f. *radiata* (Schreb.) Sandst. Podetia forming distinct cups with marginal proliferations.
32. Podetia forming broad, funnel-shaped cups. KOH + brown, Pd + red. *Cladonia conista* (Ach.) Robbins. Soredia found only on cups. On ground.
33. KOH —, Pd + red. *Cladonia chlorophaea* (Flk.) Spreng. On ground and rotting wood. Very common. f. *carpophoru* (Flk.) Anders.

- Podetia fertile. Apothecia usually borne on proliferations from margins of cups.
33. KOH —, Pd —... *Cladonia Grayi* Merrill. On ground and rotting wood. Very common. f. *carpophora* Evans. Podetia fertile. Apothecia usually borne on proliferations from margins of cups. f. *prolifera* Sandst. Cup-forming proliferations from margins of primary cups. f. *squamulosa* Sandst. Podetia squamulose.
34. Apothecia red.....35
34. Apothecia brown.....40
35. Podetia esorediose, simple or branched, with or without squamules. Apothecia almost always present... *Cladonia cristatella* Tuck. On ground, rotting wood and bark. Very common. f. *ochrocarpia* Tuck. Apothecia yellow, to flesh colored. f. *simulata* Robbins. Bearing minute, clustered, pale apothecia on short lateral outgrowths of main podetial axes. f. *squamosissima* Robbins. Apothecia red. Podetia densely squamulose. f. *vestita* Tuck. Apothecia red. Podetia squamulose.
35. Podetia sorediose.....36
36. Thallus yellowish-green. Primary squamules densely farinose-sorediose, often crust-like... *Cladonia incrassata* Flk. On rotting wood. Fairly common.
36. Thallus greenish gray or whitish.....37
37. Podetia densely covered with coarse granules and squamules, usually falling away at tips to expose whitish medulla. KOH —, Pd —, or Pd + pale yellow... *Cladonia didyma* (Fée) Vainio. On rotting wood.
37. Podetia covered with farinose, rarely granular soredia.....38
38. KOH + yellow, Pd + red... *Cladonia macilentia* Hoffm. On rotting wood and ground. Common.
38. KOH —, Pd —.....39
39. Podetia usually decorticate and farinose sorediate throughout length except small basal portion, slender... *Cladonia bacillaris* (Ach.) Nyl. On rotting wood and ground. Very common. f. *clavata* (Ach.) Vainio. Forms with simple podetia which are blunt at tips; usually sterile. Apothecia, if present, always terminal. f. *reagens* Evans. Podetia with yellowish-brown spots. KOH +, purple red.
39. Podetia not decorticate throughout; farinose sorediate in upper parts... *Cladonia Floerkeana* (Fr.) Flk. On rotting wood and ground. f. *trachypoda* (Nyl.) Vainio. Podetia large, well developed, bearing cups; partly decorticate.
40. Primary squamules containing large granules along the margins, forming a dense, granular crust. Podetia granulose sorediate. Thallus small, delicate... *Cladonia delicata* (Ehrh.) Flk. On rotting wood. Fairly common.
40. Primary squamules not forming a granular crust.....41
41. Primary squamules small, usually 1 mm. long or less.....42
41. Primary squamules large.....43
42. Podetia small, simple or branched sparingly at tips, usually contorted. Apothecia large, turban-like, dark brown. KOH + yellow, Pd + red... *Cladonia capitata* (Michx.) Spreng. (Syn. *C. mitrula* Tuck.) On ground. Fairly common.
42. Podetia larger, often squamulose, producing short branches at tip. Apothecia large, buff or lavender... *Cladonia piedmontensis* Merrill, f. *squamulosa* Robbins. On ground. Podetia squamulose.

43. KOH + red, Pd + yellow. Podetia grayish-green, peg or rod-shaped. Apothecia lumpy and irregular. . . . *Cladonia subcariosa* Nyl. On ground. f. *squamulosa* Robbins. Podetia squamulose. . . . 44
43. KOH — 44
44. Podetia esorediose, grayish-green, simple or sparingly branched. KOH —, Pd + red. . . . *Cladonia clavulifera* Vainio, f. *nudicaulis* Evans. On ground. Podetia simple or little branched, lacking squamules except at base. Apothecia large, one or several. . . . 45
44. Podetia sorediose. 45
45. Soredia farinose. 46
45. Soredia granular, or if farinose, mixed with granules. 47
46. Tips of podetia pointed, horn-like. KOH —, Pd + red. . . . *Cladonia coniocraea* (Flk.) Spreng. . . . 46
46. Tips of podetia blunt. KOH —, Pd + red. . . . *Cladonia fimbriata* (L.) Fr. . . . 47
47. Podetia covered with farinose soredia mixed with coarse granules. . . *Cladonia cylindrica* Evans. 48
47. Soredia granular. 48
48. Podetia long, usually over 15 mm.; soredia occurring only in upper parts. *Cladonia nemoryna* (Ach.) Nyl. . . . 48
48. Podetia short, less than 15 mm.; podetia sorediate throughout. . . *Cladonia pityrea* (L.) Hoffm. . . . 48

STEREOCAULON

1. Primary thallus persistent, crustose, well developed. Stalks small, usually less than 1 cm., simple or sparingly branched, tips densely sorediate. . . . *Stereocaulon pileatum* Ach. On rocks. . . . 2
1. Primary thallus disappearing. Stalks rather long, well developed esorediose. 2
2. Stalks densely covered with coralloid squamules and granules. Usually fruiting. Pd + orange red. . . . *Stereocaulon dactylophyllum* Flk. (Syn. *S. coralloides* Fr.) On rocks. . . . 2
2. Stalks not densely covered with coralloid squamules and granules. Rarely fruiting. Pd + faint sulfur yellow. . . . *Stereocaulon evolutoides* (H. Magn.) Frey. On rocks. Common. . . . 2

USNEA

1. Thallus short, erect, shrub-like, sorediose, abundantly fibrillose. . . *Usnea hirta* (L.) Wigg. On bark. . . . 3
1. Thallus short, erect, shrub-like, esorediose, less abundantly fibrillose. . *Usnea florida* (L.) Web. On bark. Fairly common. . . . 3

KEY TO THE GENERA OF FOLIOSE LICHENS

1. Thallus brightly colored, yellow or orange. 2
1. Thallus not brightly colored. 3
2. Thallus yellow; KOH — . . . *Candelaria concolor* (Dicks.) Arn. On bark. Thallus small, finely divided; lobes small, finely incised, sorediate or granulose. Apothecia very small, scattered, circular, yellow to orange. Var. *effusa* (Tuck.) Merrill & Burnh. Very common. Thallus reduced almost wholly to a powdery crust. . . . 2
2. Thallus yellowish to orange; KOH +, red to purple. . . *Xanthoria candelaria* (L.) Kickx. Found on elm trees along roadsides. Thallus of rather deeply cut, branched and imbricated lobes the margins of which are densely granulose or powdery, sometimes forming a thick powdery crust. . . . 2

3. Thallus fastened by a central point below. 4
3. Thallus fastened by several or more points or rhizinae. 5
4. Fruit bodies perithecia, immersed in thallus, globose, appearing outwardly as spots or small warts. Thallus pale on underside. . . *DERMATOCARPON*, p. 82.
4. Fruit bodies apothecia, sessile on thallus, round or angular. Thallus blackish on underside. *UMBILICARIA*, p. 84
5. Lower surface reticulated with distinct veins. . . *Peltigera canina* (L.) Willd. On ground. Apothecia large, margins rolled backward, borne on tips of extended lobes.
5. Lower surface not veined. 6
6. Lobes elongated, narrow. Upper cortex compact, well developed. . *Anaptychia hypoleuca* (Muhl.) Mass. On bark.
6. Lobes not greatly elongated. Upper cortex loose, not compact. 7
7. Rhizinae usually quite numerous. 8
7. Rhizinae scarce or absent. 9
8. Spores two-celled, dark. Underside of thallus usually white, rarely brown or black. *PHYSICIA* and *PYXINE*, p. 83
8. Spores simple, uncolored. Underside of thallus most always brownish to blackish. *PARMELIA*, p. 82
9. Thallus hollow; tips usually bursting, densely sorediate; rhizinae absent. . . . *Hypogymnia physodes* (L.) Nyl. On bark, very common.
9. Thallus not hollow; rhizinae scarce. *CETRARIA*, p. 82

CETRARIA

1. Thallus brownish. 2
1. Thallus greenish-gray. 3
2. Thallus having scattered brown or black tubercles. Apothecia originating from under surface. . . . *Cetraria ciliaris* Ach. On bark.
2. Thallus having no tubercles. Apothecia, if present, originating from upper surface. . . *Cetraria islandica* (L.) Ach. On ground in pine woods. Stalks strap-shaped, forking, thin, curling when dry to form a trough-like structure.
3. Thallus irregularly lobed; lobes usually curled away from substrate; margins undulate, somewhat crenulate, covered with dense pale green soredia; undersurface brown. . . . *Cetraria Oakesiana* Tuck. On bark.
3. Thallus lobes channeled and pitted, margins ascending, usually irregularly jagged and torn; undersurface pitted, white or brown near the tips, black at the base. . . . *Cetraria Tuckermanii* Oakes.

DERMATOCARPON

1. Growing on rocks submerged in water. Undersurface veined. Thallus lobes not pruinose when dry. . . *Dermatocarpon aquaticum* (Weis.) Zahl. Found only in one location, on a rock in a stream which normally dries up in the summer months.
1. Growing on rocks in dry situations. Undersurface not veined. Thallus lobes much imbricated, pruinose when dry. . . *Dermatocarpon minutum* (L.) Mann, var. *complanatum* (Lightf.) Th. Fr.

PARMELIA

1. Thallus sorediose. 2
1. Thallus esorediose. 5

2. Soredia developing in rows, along cracks in the thallus or along the margins.....*Parmelia sulcata* Tayl. On bark. Very common.
2. Soredia not in rows.....3
3. Thallus brown, with small warts breaking down into soredia.....*Parmelia subaurifera* Nyl. On bark. Very common.
3. Thallus not brown, without warts.....4
4. Thallus yellowish-green; undersurface brown or black.....*Parmelia caperata* (L.) Ach. On bark and rocks. Very common.
4. Thallus greenish to bluish-gray; undersurface pale to drab.....*Parmelia dubia* (Wulf.) Mass. (Syn. *P. Borreri* Turn.) On bark.
5. Thallus containing few blackish cilia along margins; rather broad-lobed.....*Parmelia perforata* (Wulf.) Ach. On bark.
5. Thallus not ciliate, not broad-lobed.....6
6. Thallus reticulate-rimose, having a network of chinks and cracks, greenish to bluish-gray.....7
6. Thallus not reticulate-rimose, yellowish-green.....*Parmelia conspersa* (Ehrh.) Ach. On rocks and bark. Very common. var. *stenophylla* Ach. Lobes rather narrow and imbricated. No isidia. f. *isidiata* (Anzi) Berry. Thallus densely covered with isidia.
7. Under surface pale.....*Parmelia rudecta* Ach. On bark. Very common.
7. Under surface black.....*Parmelia saxatilis* (L.) Ach. On rocks and bark. Common.

PHYSICIA and PYXINE

1. Thallus sorediose.....2
1. Thallus lacking soredia, esorediose.....8
2. Medulla yellow; apothecia lecidine.....*Pyxine sorediata* (Ach.) Fries. On bark.
2. Medulla white or orange; apothecia lecanorine.....3
3. Lobes ascending, free from substratum.....4
3. Lobes adnate, flattened, not ascending.....5
4. Lobes helmet or hood-shaped, with long cilia along margins; soredia within these hood-like pustules. KOH = ..*Physcia ascendens* Bitt. On bark.
4. Lobes finely incised, not hood-shaped, small, short. KOH \pm yellow.....*Physcia millegrana* Degel. (Syn. *P. tribacia* (Ach.) Nyl.) On bark. Very common.
5. Lobes very thin, adglutinated to the substratum.....*Physcia elaeina* (Sm.) A. L. Sm. On bark.
5. Lobes rather thick, not adglutinated to the substratum.....6
6. Medulla orange.....*Physcia orbicularis* (Neck.) Pösch., f. *rubropulchra* Degel. On bark. Very common.
6. Medulla white.....7
7. Thallus gray or whitish, without brownish tinge.....*Physcia leucoleiptes* (Tuck.) Lettau. On bark.
7. Thallus brownish or olive-gray.....*Physcia orbicularis* (Neck.) Pösch. On bark.
8. Thallus pruinose, having powdery appearance.....*Physcia pulverulenta* Hampe. On bark.
8. Thallus not pruinose. Cortex KOH + yellow.....9
9. Lobes with marginal cilia.....*Physcia leptalea* (Ach.) DC. On bark.
9. Lobes without marginal cilia.....10
10. Thallus gray, with white spots. Medulla KOH + yellow.....*Physcia aipolia* (Ehrh.) Hampe. On bark.

10. Thallus gray, without white spots. Medulla KOH — . . . *Physcia stellaris* (L.) Nyl. On bark. Very common. f. *tuberculata* Kernst. Lobes densely covered with tubercles, except at tips. var. *rosulata* (Ach.) Nyl. Lobes are wide, fan shaped at the tips.

UMBILICARIA

1. Thallus pustulate, blistered or pimpled; undersurface pitted . . . *Umbilicaria papulosa* (Ach.) Nyl. On rocks.
1. Thallus not pustulate 2
2. Undersurface having grilled or laced appearance. Thallus margins commonly curling under, inrolled. Apothecia common *Umbilicaria Mühlenbergii* (Ach.) Tuck. On rocks.
2. Undersurface hairy. Thallus margins not curling under. Apothecia rare. . . *Umbilicaria mammulata* (Ach.) Tuck. (Syn. *Gyrophora Dillenii*, *U. Dillenii*). On rocks.

GLOSSARY

- Adnate*. Adhering or touching broadly to the substratum.
Apothecium. An open cup- or saucer-shaped fruiting body in which the cavity is lined with a palisade-like layer of microscopic asci which bear the spores.
Areolate. Marked out in little spaces or islands.
Ascus. (Asci). A sac-like cell in which the spores are developed.
Ascyphous. Podetia without cups.
Caespitose. Growing in low tufts or patches.
Ciliate. Having hairs or cilia.
Coralloid. Coral-like outgrowths usually on thallus.
Cortex. Outer layer of the thallus.
Corticate. Covered with a continuous cortex.
Cylindrical. Having the same diameter throughout the length.
Dorsiventral. With two unlike sides, the upper surface differing from the lower surface.
Farinose. Meal-like; mealy.
Fibrillose. Provided with fibers.
Flaccid. Soft and flabby; limp.
Granulose. Covered with minute granules. Almost powdery.
Gyrose. Convoluted; folded; wavy.
Imbricate. Overlapping like shingles.
Isidium. (Isidia). A coral-like outgrowth produced on the thallus.
KOH. Potassium hydroxide (aqueous solution—15–25%).
Lacunose. Covered with pits or depressions.
Lecanorine. Type of apothecium which has a rim consisting of and the same color as the thallus.
Lecideine. Type of apothecium which does not have a thallus rim.
Medulla. Made up of loosely interwoven strands or hyphae; can be observed when outer cortex is scraped off.
Pd. Paraphenylenediamine (fresh saturated alcohol solution).
Perithecium. A flask-shaped, rounded or oval fruit-body in which the spores are borne; lined with a palisade-like layer of asci, but with a small opening (ostiole) at the tip.
Podetium. A stalk-like elevation arising from the thallus; bears the fruit-body.
Primary thallus. Characterized by a horizontal and stratosed thallus from which arises the secondary or radiate thallus termed the podetium.

Pruinose. A finely powdered surface.

Pustule. A blister or pimple-like structure.

Pycnidium. (*Pycnidia*). Small flask-shaped structures immersed in thallus.

Reticulate. Lines, veins, or ridges crossing each other to form or give the appearance of a net.

Reticulate-Rimose. A network of cracks or chinks.

Rhizoid. A single thread-like filament (hypha) or a bundle of hyphae extending from lower surface of the thallus and serving to attach the lichen to the substratum.

Scyphus. Cup-like dilation of the podetium.

Serrate. Saw-toothed margin.

Sessile. With no stalk.

Soredium. One or more algal cells surrounded or enveloped by fungal hyphae (threads). Masses of these when formed on the thallus give it a scattered or localized powdery or granular appearance.

Spore. The reproductive cell produced by the fungus.

Squamule. A small scale.

Squamulose. With minute scales.

Substrate. The substance or material to which the lichen is attached.

Thallus. The assimilative body consisting of algal and fungal components.

Tubercle. Any knob-like or wart-like elevation of the surface.

Umbilicus. The central point by which means the thallus is attached to the substratum.

Veined. Having raised lines or vein-like structures.

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THREE CHANGED AUTHORITIES FOR COMBINATIONS.—Recently, I had occasion to examine, page by page, the first 111 volumes of Curtis's Botanical Magazine, in search of varietal names of American plants for inclusion in the Gray Herbarium Card Index. In the course of this examination, three instances were found in which the current attributions of authorities and places of publication are incorrect.

Aquilegia formosa, var. *flavescens* (S. Wats.) J. K. Henry, Fl. So. Brit. Columbia, 137 (1915) is antedated by ***Aquilegia formosa***, var. ***flavescens*** (S. Wats.) Hook. f. in Curtis, Bot. Mag. 107: tab. 6552 (1881).

Mimulus luteus, var. *cupreus* (Regel) Hoss. in Trab. Inst. Bot. Farm. Buenos Aires, no. 33: 71 (1915) is antedated by ***Mimulus luteus***, var. ***cupreus*** (Regel) Hook. in Curtis, Bot. Mag. 90: tab. 5478 (1864).

Vaccinium corymbosum, var. *fuscatum* (Ait.) A. Gray, Syn. Fl. 2, pt. 1: 23 (1878) is antedated by ***Vaccinium corymbosum***, var. ***fuscatum*** (Ait.) Hook. in Curtis, Bot. Mag. 62: tab. 3433 (1835).—
ROBERT C. FOSTER, GRAY HERBARIUM.

SOME IDENTITIES IN HALEZIA (STYRACACEAE)

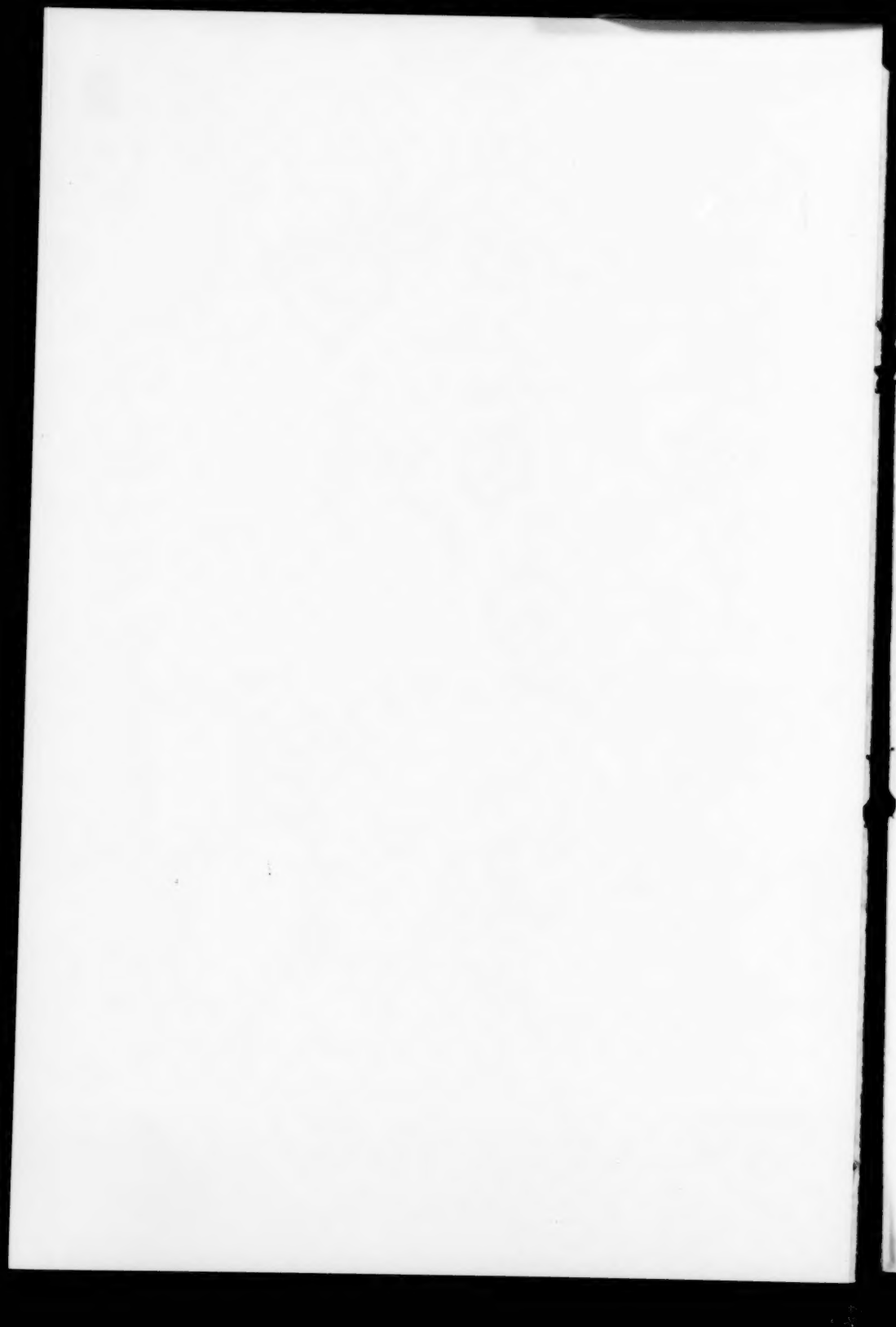
R. K. GODFREY¹

In western Florida, from the Tallahassee Red Hills area westward, the two-wing silverbell, *Halesia diptera* Ellis, comprises two populations: a larger flowered population which in general grows in mixed woodlands of upland slopes in the Tallahassee Red Hills, mixed woodlands of bluffs and ravine slopes along the Apalachi-

¹ Expenses incurred in field work contributing to this research were met with funds made available to the author by a grant from the National Science Foundation (G-2010). Herbarium assistance was made possible by a grant from the Research Council, Florida State University.



Halesia tetraptera Ellis, fig. A. *Halesia diptera* Ellis, fig. B. After Ellis.



cola and Chipola Rivers, and mixe l wood lan ls of the uplan ls hav- ing limestone outcropp in the vicinity of Marianna; a smaller flowered population which grows in the broad floodplain forests of the Choctawhatchee and Escambia Rivers and in lesser floodplains of smaller streams between. I have, as yet, no reason to believe that the larger flowered form is of more widespread distribution than from the Tallahassee to the Marianna area. Neither have I, to date, encountered any of the smaller flowered form within this limited range. The smaller flowered one, in western Florida occurring from about the Choctawhatchee River westward, is a part of a much more extensive population extending westward to Texas and northeastward to the Savannah River (or thereabouts).

Aside from habitat and distribution differences, the only morphological differences between these two-wing silverbells is that of flower size. This is conspicuous as one views the trees, those of the larger flowered form being nearly twice the size (the form and proportions being the same) of the smaller flowered one. However, when flowering material is carefully pressed, the size difference is less strikingly apparent in herbarium specimens. The flowers shrink considerably in drying.

Although in the non-flowering condition, the two-wing silverbells are not distinguishable, it seems advisable to give them varietal designations. This necessitates, of course, ascertaining what Ellis may have had when he described *Halesia diptera*. The species was described by Ellis in the Philosophical Transactions of the Royal Society, London, 51: 931, t. 22, fig. B (1791). This is in the paper in which he also described (and figured much more fully) *H. tetraptera* the identity of which is considered below. At the conclusion of his discussion of *H. tetraptera*, Ellis wrote (of *H. diptera*) as follows:

"About two years ago, I received from Governor Ellis of Georgia another species of this tree, which was sent him by Mr. De Brahme, from Augusta in Georgia, three hundred miles up the river Savannah.

"The fruit of this kind has two wings, as described in the plate, at B."

There follows a diagnosis of *Halesia*, then the following species designations:

The species are,

- | | |
|-------------|---|
| TETRAPTERA. | 1. <i>HALESIA fructibus</i>
<i>membranaceo-quadrangulatis.</i> |
| DIPTERA. | 2. <i>HALESIA fructibus alatis.</i> |

From this, and in the light of my present knowledge of the distribution of the smaller and larger flowered forms of *Halesia diptera*, it may be inferred that the species is based on material of the smaller flowered one which thus becomes *Halesia diptera* Ellis var. *diptera*. Fresh flowers of this are 1.0–1.5 cm. long at anthesis. The width of the corolla varies because the petals spread variously. The individual petals are oval, oblong, or obovate, 1.0–1.5 cm. long and 0.8–1.0 cm. broad at their broadest places, the tips obtuse or rounded. The androecium length is equal to that of the petals, the filaments united at base.

The larger flowered form I designate as ***Halesia diptera* var. *magniflora***, var. nov. Var. *diptera similis sed floribus maioribus. Floribus 2–3 cm. longis, 1.0–1.5 cm. latis. Petalis 2–3 cm. longis, 1.0–1.5 cm. latis, ovalibus, oblongis, ad obovatis.* Type specimen: deciduous woods, ravine slope, 1.5 miles east of Tallahassee, Florida, Godfrey no. 54434 (Herbarium of Florida State University).

Halesia tetraptera Ellis (l. c. 930–931, t. 22, fig. A) was described from material sent to England from along the banks of the Santee River in South Carolina. The plate (fig. A) accompanying the description, which is here reproduced, admirably portrays flowering material and a fruiting branch. This seems to me clearly and unequivocally identifiable with the little silverbell of the coastal plain, *Halesia parviflora* Michaux (Flora Boreali-Americana 2: 40. 1803), and not with the much larger flowered silverbell of the uplands and interior, *Halesia carolina* L., with which it has long been identified.

Halesia tetraptera Ellis is the earlier name and the one which should be applied to the tree which we are currently calling *H. parviflora* Michx.—DEPARTMENT OF BIOLOGICAL SCIENCES, FLORIDA STATE UNIVERSITY, TALLAHASSEE, FLORIDA.

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